

zone before the canal was dug. The absence of shells above this level may be attributed to the leaching action of rain water that, in percolating downward, dissolved the shells. The absence of shells from terrace deposits higher than the Pamlico has been advanced as an argument against the marine origin of the higher terraces; but most of the higher terrace deposits are porous and have been subjected to leaching for a longer time than the Pamlico formation.

The sequence of late Pleistocene events that can be inferred from the sections near Myrtle Beach, on Neuse River, and from other evidence is as follows: First, a lowering of sea level from the 42-foot Talbot stage to a depth estimated by Stearns<sup>5</sup> as about 60 feet below the present level; next, a rise of sea level to approximately its present position and deposition of the Horry clay in estuaries filling valleys cut in the Talbot terrace during the preceding epoch; then, continued rise of sea level to a height of 25 feet, expansion of the Horry estuaries, and deposition of the Pamlico formation; next, fall of sea level to a depth at least 25 feet lower than the present, indicated by submerged channels in Pamlico Sound and elsewhere; finally, rise of the sea to its present level, drowning the valleys and lowlands of the preceding epoch to form the existing sounds and estuaries.

I have elsewhere<sup>6</sup> tentatively correlated the Pamlico formation with the last major interglacial stage, commonly called Peorian—a correlation that seems to be confirmed by the studies of MacClintock and Richards.<sup>7</sup> The Horry clay apparently represents the early part of the same stage.

PALEONTOLOGY.—*Pliocene and Pleistocene mollusks from the Intracoastal Waterway in South Carolina.*<sup>1</sup> W. C. MANSFIELD and F. S. MACNEIL.

In June, 1935, and again in April, 1936, the writers visited the Intracoastal Waterway at North Dam (Location Contract 195) about 3 miles west-southwest of Little River and about 15 miles northeast of Myrtle Beach, S. C. The canal here traverses a low plain, which as interpreted by Cooke,<sup>2</sup> is the southward continua-

<sup>5</sup> STEARNS, H. T., *Geol. Soc. Am. Bull.* **46**: 1941. 1935.

<sup>6</sup> COOKE, C. W. *Tentative ages of Pleistocene shore lines.* *This JOURNAL* **25**: 333. 1935.

<sup>7</sup> MACCLINTOCK, PAUL, and RICHARDS, H. G. *Correlation of late Pleistocene marine and glacial deposits of New Jersey and New York.* *Geol. Soc. Am. Bull.* **47**: 317. 1936.

<sup>1</sup> Published by permission of the Director, U. S. Geological Survey. Received October 12, 1936.

<sup>2</sup> COOKE, C. W. *Geology of the Coastal Plain of South Carolina.* U. S. Geol. Survey Bull. **867**: 125-126. 1936.



Fig. 1.—Intracoastal waterway canal, June, 1935, at North Dam (Location contract 195) about 3 miles west-southwest of Little River and about 15 miles northeast of Myrtle Beach, S. C. The rock on which the senior author stands is referred to the Pliocene epoch (see No. 1 of section).

tion of the Pamlico terrace plain of North Carolina. The purpose of this paper is to record the species of mollusks collected at North Dam, both those in place from the different beds in the canal banks and those thrown out by the dredge along the spoil banks. These faunas are compared with those from other areas and certain species not heretofore recorded from this area are indicated.

The section exposed at this locality is as follows:

Recent:	Feet
6. Cross-bedded white to tan sand . . . . .	8 ±
Pleistocene (Pamlico formation):	
5. Dark gray, rather fine clayey sand, carrying many fossils (U. S. Geol. Survey nos. 13424, 13813 . . . . .	3 ±
4. Sand (of dune origin?) . . . . .	3 ±
3. Alternating layers of cross-bedded sand and peat, the peat in places grading laterally into sand . . . . .	3 ±
2. Dark gray clayey sand, some of the sand grains large and irregular, carrying many individuals of <i>Mulinia lateralis</i> , <i>Ostrea virginica</i> and other shells; this bed changes laterally in character and thickness, being more clayey and fossiliferous where it occupies depressions in the underlying bed and more sandy and cross-bedded as it becomes thinner; in places the lower	

part of the carbonaceous bed (no. 3) rests directly on the Pliocene (bed 1) (U. S. Geol. Survey no. 13425)..... 0-3

Unconformity.

Pliocene (Waccamaw formation):

1. Indurated, light gray, highly calcareous marl with a minor amount of rather fine quartz sand, carrying fragmental and entire mollusks, corals, encrusting bryozoa and echinoderms (U. S. Geol. Survey no. 13426)..... (above water level)..... 4±

The species collected from layers 1, 2, and 5, and from the spoil bank are listed below.

LIST OF SPECIES FROM LAYER 5

*Aceteocina canalicula* (Say), *Terebra dislocata* (Say), *Terebra concava* (Say), *Ilyanassa obsoleta* (Say), *Anachis avara* Say, *Epitonium angulatum* Say, *Melanella* sp., *Turbonilla*, 2 or more species, *Seila adamsii* (H. C. Lea), *Crepidula fornicata* (Linnaeus), *Nucula proxima* Say, *Arca transversa* Say, *Noetia ponderosa* (Say), *Argina pexata* (Say), *Ostrea virginica* Gmelin (?), *Anomia simplex* D'Orbigny, *Mytilus* sp., *Lyonsia* aff. *L. floridana* Conrad, *Phacoides multilineatus* Tuomey and Holmes, *Cardium robustum* Solander, *Cardium muricatum* Linnaeus, *Chione cancellata* (Linnaeus), *Venus* sp., *Venus mercenaria* Linnaeus, *Gemma purpurea* H. C. Lea, *Tellina* cf. *sayi* (Deshayes) Dall, *Semele proficua* Pulteney, *Cumingia tellinoides* (Conrad), *Tagelus gibbus* (Spengler), *Tagelus divisus* Spengler, *Mulinia lateralis* Say, *Anatina canaliculata* (Say), *Barnea (Scobina) costata* (Linnaeus).

This fauna is of very late Pleistocene age. Of the 26 species all, or nearly all, are now living somewhere along the Atlantic coast.

LIST OF SPECIES FROM LAYER 2

*Aceteocina canaliculata* (Say), *Cylichnella bidentata* (D'Orbigny), *Terebra* sp., *Mangelia cerina* Kurtz and Stimpson, *Olivella nitidula* Dillwyn, *Marginella apicina* Menke, *Marginella* sp., *Busycon caricum* (Gmelin), *Busycon perversum* (Linnaeus), *Cantharus tinctus* Conrad, *Alectrion acuta* Say, *Alectrion trivittata* (Say), *Ilyanassa obsoleta* (Say), *Anachis obesa* C. B. Adams, *Mitrella lunulata* Say, *Urosalpinx cinerius* Say, *Eupleura caudata* Say, *Epitonium* sp., *Turbonilla*, 2 or more sp., *Semicassis inflata* Shaw, *Ficus papyratia* Say, *Triphora nigrocincta* C. B. Adams, *Cerithiopsis subulata* Montagu, *Vermicularia spirata* (Philippi), *Turritella* sp., *Crepidula fornicata* (Linnaeus), *Crepidula plana* Say, *Calyptrea centralis* Conrad (?), *Polinices (Neverita) duplicatus* (Say), *Diodora alternata* (Say), *Nucula proxima* Say, *\*Glycymeris americana* DeFrance, *\*Arca lienosa* Say, *Arca transversa* Say, *Argina pexata* (Say), *Noetia ponderosa* (Say), *"Fossularca" adamsi* Dall, *Ostrea virginica* Gmelin, *\*Pecten eboreus solariodes* Heilprin, *\*Plicatula marginata* Say, *Cardita* sp. (young), *\*Cardita arata* (Conrad), *\*Venericardia granulata* Say, *Chama* sp., *\*Phacoides* cf. *P. waccamawensis* Dall, *Diplodonta semiaspera* Philippi, *\*Diplodonta acclinis* Conrad, *Bornia* cf. *B. triangulata* Dall, *Dosinia elegans* (Conrad), *Chione latilirata athleta* Conrad, *Venus* sp., *Tellina sayi* (Deshayes) Dall, *Cumingia tellinoides* (Conrad), *Abra aequalis* (Say),

*Tagelus gibbus* (Spengler), *Spisula* cf. *S. similis* Say, *Mulinia lateralis* Say, *Anatina canaliculata* (Say), *Corbula barrattiana* C. B. Adams, *Corbula contracta* Say, Coral.

The sediments of layer 2 were probably deposited during Pleistocene time. Of about 62 species listed, 8 are believed to have lived during Pliocene time (marked in the list with an asterisk\*) and to have been redeposited in the Pleistocene sediments.

The water level in the canal was about 4 feet higher during our last than during our first visit and consequently the lower part of layer 2, seen during our first visit, was under water. All of the presumably reworked Pliocene species were collected during our first visit from depressions in the underlying Pliocene bed and at the time were thought to have been in place in the base of layer No. 2. However, the possibility that they may have slipped down the bank from overlying dredged material, is recognized.

The following species are not known to have lived earlier than Pleistocene time: *Busycon caricum* (Gmelin), *Cantharus tinctus* Conrad, *Alectrion trivittata* (Say), *Ilyanassa obsoleta* (Say), *Urosalpinx cinerius* Say, *Semicassis inflata* Shaw, *Argina pexata* (Say), *Noetia ponderosa* (Say), *Cumingia tellinoides* (Conrad), *Anatina canaliculata* (Say) and others.

LIST OF SPECIES FROM THE UPPER PART OF THE  
PLIOCENE, LAYER NO. 1

*Olivella mutica* Say, *Fusinus* cf. *F. carolinensis* Dall, *Ilyanassa porcina* Say, *Nucula proxima* Say, *Glycymeris americana* (DeFrance), *Pecten eboreus senescens* Dall, *Crassinella lunulata* (Conrad), *Venericardia abbreviata* Conrad?, *Phacoides multilineatus* (Tuomey and Holmes), *Diplodonta acclinis* (Conrad), *Cardium* sp., *Laevicardium mortoni* Conrad, *Venus* sp., *Tellina sayi* (Deshayes), *Mulinia lateralis* Say, *Poromya* sp., *Corbula barrattiana* C. B. Adams, *Corbula contracta* Say.

LIST OF SPECIES FROM THE SPOIL BANK

*Terebra dislocata* (Say), *Terebra* aff. *dislocata* (Say), *Terebra concava* (Say), *Conus adversarius* Conrad, *Conus floridanus* Gabb (C), "*Drillia*" *ebenia* Dall (C), "*Drillia*" aff. *pagodula* Dall (C?), *Cymatosyrinx lunata* (H. C. Lea), *Mangilia* sp., *Cancellaria* cf. *C. carolinensis* Emmons, *Oliva sayana* (Ravenel), *Olivella nitidula* Dillwyn, *Marginella* aff. *M. limatula* Conrad, *Scaphella* (*Aurinia*) *floridana* (Heilprin) (C), *Aurinia obtusa* Emmons, *Fasciolaria* sp. (N), *Fasciolaria apicina* Dall, *Busycon carica* Gmelin (P?), *Busycon perversum* (Linnaeus), *Busycon pyrum* Dillwyn, *Busycon* sp. (N), *Fusinus carolinensis* (Dall), *Fusinus* sp., *Alectrion acuta* (Say) (P), *Alectrion vibex* (Say) (C), *Ilyanassa obsoleta* (Say) (P), *Ilyanassa irrorata* Conrad, *Ilyanassa isogramma* Dall, *Alectrion* aff. *ambigua antillarum* D'Orbigny (C), *Anachis avara caloosaensis* Dall, *Ocenebra alta* Dall (C), *Eupleura caudata* Say (P), *Murex pomum* Gmelin, *Murex rufus* Lamarek, *Purpura fluvi-*

ana Dall (C), *Coralliophila lepidota* Dall, *Urosalpinx cinerius* (Say) (P), *Urosalpinx* sp. (N), *Ficus papyratia* (Say), *Petalocochus irregularis* D'Orbigny (P), *Turritella subannulata* Heilprin, *Turritella* sp. (P?), *Crepidula fornicata* (Linnaeus), *Crepidula cymbaeformis* Conrad, *Crepidula plana* Say, *Polinices* (*Neverita*) *duplicata* (Say), *Natica canrena* Linnaeus, *Diodora* cf. *D. alternata* (Say), *Nuculana acuta* (Conrad), *Glycymeris americana* (De-France), *Glycymeris pectinata* (Gmelin), *Acar reticulata* Gmelin (C), *Arca plicatura* Conrad?, *Arca transversa* Say (P), *Arca lienosa* Say, *Arca rustica* Tuomey and Holmes (N), *Arca* (*Cunearca*) *incongrua* Say (P), *Argina pexata* Say (P), *Navicula umbonata* Lamarck (P?), *Navicula wagneriana* (Dall) (C), *Fossularca adamsi* Dall, *Noetia ponderosa* (Say) (P), *Ostrea sculpturata* Conrad, *Ostrea virginica* Gmelin (P), *Ostrea* aff. *O. trigonalis* Conrad, *Pecten eboreus senescens* Dall, *Pecten evergladensis* cf. *charlottensis* Mansfield (C), *Pecten eboreus solaroides* Heilprin (W), *Pecten ernest-smithi* Tucker (N), *Amusium mortoni* Ravenel, *Plicatula marginata* Say, *Anomia simplex* D'Orbigny, *Modiolus* cf. *M. gigantoides* Olsson (W), *Astarte concentrica bella* Conrad, *Crassinella dupliniana* Dall, *Crassinella lunulata* (Conrad), "*Eucrassatella*" *gibbesii* (Tuomey and Holmes), "*Eucrassatella*" *mansfieldi* MacNeil (C, N, W), *Cardita arata* (Conrad), *Venericardia granulata* Say, *Venericardia tridentata* Say, *Chama striata* Emmons, *Echinochama arcinella* (Linnaeus), *Phacoides radians* (Conrad), *Phacoides anodonta* (Say), *Diplodonta acclinis* Conrad, *Laevicardium sublineatum* (Conrad), *Cardium* cf. *isocardia* Linnaeus, *Cardium muricatum* Linnaeus (P), *Chione latilirata* Conrad, *Chione cribraria* (Conrad), *Chione cancellata* (Linnaeus), *Venus campechiensis permagna* Conrad, *Venus mercenaria* Linnaeus, *Macrocallista reposta* Conrad, *Tellina* cf. *T. propetenella* Dall, *Macoma balthica* Linnaeus (P), *Semele bella-striata* Conrad (C), *Semele proficua* Pulteney (P), *Semelina nuculoidea* Conrad (P?), *Tagelus gibbus* Spengler (P), *Spisula* aff. *similis* Say, *Mulinia lateralis* Say, *Corbula inaequalis* Say, *Barnea costata* Linnaeus (P).

The capital letters used in the preceding list are explained as follows: (P) probably Pleistocene; (C) present also in the Caloosahatchee marl (Pliocene) of western Florida but not previously reported from the Waccamaw formation in the adjacent area to the west of the canal; (N) present also in the Pliocene at Neills Eddy Landing, 5 miles N. E. of Acme, N. C.; (W) present also in the Pliocene in the upper bed at the north shore of Lake Waccamaw, N. C. Most of the species not followed by a letter probably came from the Pliocene as many of the specimens are incrustated with a hard matrix.

The close relationship of the Pliocene fauna or faunas dredged from the canal, to that of the Caloosahatchee marl of western Florida, to that at Neills Eddy Landing on Cape Fear River, N. C., and to that in the uppermost bed on the north shore of Lake Waccamaw, N. C., is indicated by the common occurrence at those localities of certain of the species as indicated in the list. The presence of *Navicula wagneriana* (Dall) is of particular interest as it has been known heretofore only in the Caloosahatchee marl.

No specimens of the genus *Rangia* were collected from the spoil

banks. The apparent absence of this genus, which inhabits shallow water, may indicate open and moderately deep water conditions for this area, during Pliocene and Pleistocene time.

Three species of mollusks (identified by W. C. Mansfield)—*Pecten ernestsmithi* Tucker, *Pecten eboreus senescens* Dall, and *Scaphella (Aurinia) floridana* (Heilprin), and one species and three specifically unnamed genera of echinoids—*Rhyncholampus evergladensis* (Mansfield), a *Clypeaster*, an *Encope* and a *Coelspleurus*, are recorded by Cooke<sup>3</sup> from this locality.

PALEONTOLOGY.—*A new subspecies of Pecten from the upper Miocene of North Carolina.*<sup>1</sup> W. C. MANSFIELD, U. S. Geological Survey.

In April, 1936, F. S. MacNeil and the writer obtained additional specimens of *Pecten*, among other material, from exposures along the Chowan River in Bertie and Hertford Counties, eastern North Carolina. The *Pecten* from certain localities, as noted below, was referred by the writer<sup>2</sup> to *P. (Chlamys) eboreus eboreus* Conrad, but he now believes, after procuring better specimens for comparison, that it should be referred to a new subspecies—*P. eboreus bertiensis*, described as follows:

***Pecten (Chlamys) eboreus bertiensis* Mansfield, n. subsp. Figs. 1-3**

Shell large, thin, ovate, inequilateral; hinge line rather short; left valve much more inflated than right; ornamented with 24 to 25 ribs. Right valve of cotype low, ornamented with 25 flat ribs, which are medially shallowly incised over the middle part of the disk and separated by shallow interspaces which are a little narrower than the ribs. The concentric lamellae are moderately coarse. Right ear shallowly insinuated and marked with 5 rather strong radials, those near the hinge line being the stronger; left ear with 11 moderately strong radials. Left valve of cotype with 25 ribs, narrower than interspaces and medially sulcated over the middle part of the disk and nearly flat ventrally. Both ears with about 7 radials.

Dimensions of cotypes (U.S.N.M. no. 496224): Right valve, length 86 mm; height 80 mm; convexity 11 mm; length of hinge line 44 mm. Left valve, length 95 mm; height 88 mm; convexity 24 mm; length of hinge line 50 mm.

Type locality: Station 11999, from bed exposed at beach to 10 feet above in right bank of Chowan River, three-fourths of a mile below Mount Gould Landing, Bertie County, North Carolina.

<sup>3</sup> COOKE, C. W. *Geology of the Coastal Plain of South Carolina*. U. S. Geol. Survey Bull. 867: 126. 1936.

<sup>1</sup> Published by permission of the Director of the U. S. Geological Survey. Received December 2, 1936.

<sup>2</sup> MANSFIELD, W. C. *Stratigraphic significance of Miocene, Pliocene, and Pleistocene Pectinidae in the southeastern United States*. Jour. Paleontology 10 (3): 175, stratigraphic position 17, 1936.